Utilization of the HCUP Nationwide Readmissions Database (NRD) Webinar

HCUP Webinar ♦ December 16, 2015

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Welcome

- Thank you for joining us for this Healthcare Cost and Utilization Project (HCUP) webinar on using the Nationwide Readmissions Database (NRD) designed to support national analysis of readmissions for all payers and the uninsured.

- This webinar was created for researchers who are ready to use the Nationwide Readmissions Database to produce national readmissions estimates.

- In this webinar we will walk through an example readmission analysis using the NRD that includes the following steps:

  – Defining index events

  – Determining the time between events

  – Identifying readmissions

  – Calculating nationally weighted statistics

  – Reporting readmission rates

About HCUP

Before we get started, a quick word about HCUP:

- HCUP is sponsored by the Agency for Healthcare Research and Quality (AHRQ).

- HCUP is a family of databases, software tools, and related research products that enable research on a variety of healthcare topics.

- If you are unfamiliar with HCUP or would like a refresher, please consider taking our General Overview Course.

| HCUP Databases | Research Tools | Research Publications | User Support |

HCUP has Seven Types of Databases

- Three State-level databases

State Inpatient Databases **(SID)**

State Ambulatory Surgery & Services Databases **(SASD)**

State Emergency Department Databases **(SEDD)**

- Four nationwide databases

National Inpatient Sample **(NIS)**

Nationwide Emergency Department Sample **(NEDS)**

Kids' Inpatient Database **(KID)**

Nationwide Readmissions Database **(NRD)**

Comparison of the HCUP Inpatient Databases

	HCUP Inpatient Databases			
HCUP Database	SID (2013)	NIS (2013)	KID (2012)	**NRD (2013)**
States	43 States + DC	43 States + DC	44	**21**
Hospitals	4,400	4,400	4,200	**2,000**
Inpatient discharges	33 million	7 million	3 million	**14 million**
Derived From	--	SID	SID	**SID**
Uses	Examine **State and local market area** statistics on health care utilization, access, quality, patient safety, etc. Readmission analyses possible in some States.	Generate **national and regional** estimates of health care utilization, access, quality, patient safety, etc.	Generate **national and regional** <u>pediatric</u> estimates of health care statistics.	**Generate national estimates of all-cause and condition-specific readmissions**

Uses of the NRD

Creation

- The NRD was created to support national analyses of repeat hospital use for all types of patients, regardless of the type of health insurance. Possible outcomes of interest include national readmission rates, reasons for returning to the hospital for care, and the hospital charges for discharges with and without readmissions.

Design

- The NRD is designed for analyses at the *national* level. It is not designed to support regional, State-, or hospital-specific analyses.

Sample Problem Introduction

- During this webinar, we will be looking at defining 30-day readmissions for acute myocardial infarction (AMI).

- The following five steps will be demonstrated:

  1. Define index events
  2. Determine the time between events
  3. Identify readmissions
  4. Calculate nationally weighted statistics
  5. Report readmission rates

Key Data Elements in the NRD

- Key data elements in the NRD for studying readmissions include:

NRD Data Element	Description
NRD_VisitLink	Linkage variable for all inpatient stays associated with a unique patient
NRD_DaysToEvent	Timing variable used to determine the number of days between admissions
LOS	Length of inpatient stay (nights). A value of zero indicates the patient did not stay overnight.
KEY_NRD	HCUP record identifier created specifically for the NRD

- The coding scheme for NRD_VisitLink and NRD_DaysToEvent was designed to adhere to strict privacy guidelines and protect patient confidentiality.

Example NRD Discharges (Fictitious)

- Criteria to determine the relationship between multiple hospital admissions for an individual patient in a calendar year is left to the analyst using the NRD.
- Consider 5 different patients admitted to two different hospitals in the year.

KEY_ NRD	NRD_ VisitLink	NRD_ DaysToEvent	LOS	HOSP_NRD (Cannot be linked to any other HCUP or external database)
1	A	1009	3	AAA
2	A	1024	0	BBB
3	B	2555	5	AAA
4	B	2588	4	AAA
5	C	56	2	BBB
6	C	76	3	BBB
7	D	377	4	AAA
8	E	6325	5	BBB

Step 1: Define Index Events

1. **Define index events**
2. Determine the time between events
3. Identify readmissions
4. Calculate nationally weighted statistics
5. Report readmission rates

Define Index Events: Overview

- The **index event** is typically defined by a combination of clinical criteria. Inclusion and exclusion criteria should be used to define an index event indicator (coded as 0 or 1) that identifies NRD discharges as an index event specific to the analysis of interest. The NRD does not include a variable for index events because it needs to be specific to each analysis.

Define Index Events: Inclusion/Exclusion Criteria

- Possible **inclusion** criteria include but are not limited to:
  - age of the patient
  - specific diagnoses and/or procedures
- Possible **exclusion** criteria include but are not limited to:
  - Common exclusions
    - Patient died in hospital
    - Length of stay is missing
    - Discharge month(s) later in the year
      - Exclude index events in December to allow detection of 30-day readmissions
      - Exclude index events in Oct-Dec to allow detection of 90-day readmissions
  - Analysis-specific exclusions
    - Transfers (NRD data element SAMEDAYEVENT not equal to 0)
    - Patients with complicating comorbidities

Define Index Events: AMI Example

- Our **index event** is defined as:
  - AMI is an ICD-9-CM principal diagnosis of 410.00–410.91, but not equal to ICD-9-CM 410.x2 indicating a subsequent episode of care
  - Patients age 18 years and older
  - Discharged between January and November (1 <= DMONTH <= 11)
  - Discharged alive (DIED=0)
  - LOS is not missing

Define Index Events: SAS Code

```
IndexEvent = 0;
if  not missing(NRD_DaysToEvent)
    and '41000' le DX1 le '41091' and
        substr(DX1,5,1) ne '2'
    and AGE >= 18
    and DIED = 0
    and 1 <= DMONTH <= 11
    and not missing(LOS) then do;
        IndexEvent=1;
    end;
```

Sample code to flag records fitting index criteria with IndexEvent=1.

Define Index Events: Example

- **You will need to add the variable IndexEvent to the NRD based on your analysis. This is not included on the NRD.**
- Our criteria includes age 18+ with AMI (where diagnosis does not indicate a subsequent episode) and discharged alive in Jan-Nov with a nonmissing LOS.

KEY_NRD	NRD_Visit Link	NRD_DaysTo Event	AGE	DX1 (Principal DX)	DIED	DMONTH	LOS	Index Event (added)
1	A	1009	45	AMI	0	6	3	1
2	A	1024	45	AMI	1	6	0	0
3	B	2555	67	AMI	0	2	5	1
4	B	2588	67	Broken leg	0	3	4	0
5	C	56	54	AMI	0	10	2	1
6	C	76	54	AMI (subsequent)	0	11	3	0
7	D	377	82	AMI	0	2	4	1
8	E	6325	64	AMI	0	12	5	0

Step 2: Define Time Between Events

1. Define index events
2. **Determine the time between events**
3. Identify readmissions
4. Calculate nationally weighted statistics
5. Report readmission rates

Define Time Between Events: Select Time Period

- When determining an appropriate time period for the readmission, considerations include selecting a time that considers the same risk of exposure to all patients, seasonality of the disease, and possible external factors.

- Shorter time frames (7 or 14 days) are often used to make events attributable to hospital acute care; longer time frames may reflect differences in ambulatory care and/or coordination of care.

- Centers for Medicare and Medicaid Services (CMS) uses 30 days for their readmission measures.

Define Time Between Events: NRD_DaysToEvent

- **Admission and discharge dates are not included on the NRD.**

- NRD_DaystoEvent is a count variable derived from dates.

  - ▶ NRD_DaysToEvent is the number of days from a randomly chosen "start date" for each NRD_VisitLink to the **admission date** for each of its discharges.

- The coding scheme for NRD_DaysToEvent was designed to adhere to strict privacy guidelines and protect patient confidentiality.

- DaysToEvent is reported as missing if the admission date was unavailable.

Define Time Between Events: Calculation

- Use NRD_DaystoEvent and LOS to determine the number of days between the end of one admission and the start of the next admission.

- Consider the following example:

  ► Patient A has two hospital admissions:

    ○ The NRD_DaysToEvent value is "1009" with a length of stay of 3

    ○ The NRD_DaysToEvent value is "1024" with a length of stay of 0

  ► The number of days between the <u>start of each admission</u> is 15 days (1024 – 1009 = 15) because NRD_DaysToEvent is based on the admission date.

  ► The number of days <u>between the admissions</u> (from discharge date of the first admission to the start of the second admission) is 12 days (1024 – 1009 – 3 = 12) because the patient had a 3-day length of stay.

Define Time Between Events: SAS Code

```
/* Discharge date is NRD_DaysToEvent + LOS */
if not missing(LOS) and
   not missing(NRD_DaysToEvent) then
   PseudoDDate = NRD_DaysToEvent + LOS;
```

Define a pseudo discharge date

To determine the time between two admissions in the NRD, the analyst using the NRD will need to develop code to compare PseudoDDate to NRD_DaysToEvent (based on the admission date) on a subsequent record for the same patient (NRD_VisitLink).   **There is no such variable on the NRD.**

- Determining information using two different records in a SAS data set takes careful programming using either data steps with retain statements or proc SQL.

- The NRD tutorial available on the HCUP-US Web site has an example using proc SQL.

Define Time Between Events: Example

- **You will need to calculate the days between two discharges based on your analysis. This is not included on the NRD.**

KEY_ NRD	NRD_ Visit Link	NRD_ DaysTo Event	LOS	PseudoDDate (added)	Days from last discharge (added)
1	A	1009	3	1012 = 1009 + 3	<no previous discharge>
2	A	1024	0	1024 = 1024 + 0	**12** = 1024 – 1012
3	B	2555	5	2560 = 2555 + 5	<no previous discharge>
4	B	2588	4	2593 = 2588 + 4	**28** = 2588 – 2560
5	C	56	2	58 = 56 + 2	<no previous discharge>
6	C	76	3	79 = 76 + 3	**18** = 76 – 58
7	D	377	4	381 = 377 + 4	<no previous discharge>
8	E	6325	5	6330 = 6325 + 5	<no previous discharge>

Step 3: Identify Readmissions

1. Define index events
2. Determine the time between events
3. **Identify readmissions**
4. Calculate nationally weighted statistics
5. Report readmission rates

Identify Readmissions: Overview

- The selection of criteria for readmission can dramatically change results.

- Readmission analyses tend to consider one of the following:
  - any subsequent admission regardless of cause
  - any subsequent admission that does not involve trauma
  - any subsequent admission that is unplanned
  - or any subsequent admission for a specific event such as a post-surgical infection

- A study may consider all readmissions within a time period or just the first readmission.

Identify Readmissions: SAS Code

- Detecting readmissions means examining information across two different discharge records in the NRD.

- In a SAS data set this takes careful programming using either data steps with retain statements or proc SQL.

- The NRD tutorial available on the HCUP-US Web site has an example of identifying all-cause readmissions in 30 days using proc SQL.

Identify Readmissions: Example #1

- **You will need to determine if the index event has a readmission based on your analysis. This is not included on the NRD.**

- Example #1: All-cause readmission within 30 days to <u>any</u> hospital.

KEY_ NRD	NRD_ Visit Link	HOSP_ NRD	DX1 (Principal DX)	Index Event (added)	Days from last discharge (added)	Readmit1: All-cause readmission in 30 days, any hosp (added)
1	A	AAA	AMI	1	--	1
2	A	BBB	AMI	0	12	0
3	B	AAA	AMI	1	--	1
4	B	AAA	Broken leg	0	28	0
5	C	BBB	AMI	1	--	1
6	C	BBB	AMI (subsequent)	0	18	0
7	D	AAA	AMI	1	--	0
8	E	BBB	AMI	0	--	0

- Example #2: All-cause readmission within 30 days to <u>same</u> hospital.

KEY_NRD	NRD_Visit Link	HOSP_NRD	DX1 (Principal DX)	Index Event (added)	Days from last discharge (added)	Readmit2: All-cause readmission in 30 days, <u>same</u> hosp (added)
1	A	AAA	AMI	1	--	~~1~~ 0
2	A	BBB	AMI	0	12	0
3	B	AAA	AMI	1	--	1
4	B	AAA	Broken leg	0	28	0
5	C	BBB	AMI	1	--	1
6	C	BBB	AMI (subsequent)	0	18	0
7	D	AAA	AMI	1	--	0
8	E	BBB	AMI	0	--	0

- Example #3: Unplanned readmission within 30 days to any hospital.
- Define planned readmission as DX1 of subsequent admission for AMI with coronary artery bypass graft (CABG).

KEY_NRD	NRD_Visit Link	HOSP_NRD	DX1 (Principal DX)	PR1 (First PR)	Index Event (added)	Days from last discharge (added)	Readmit3: Unplanned readmission in 30 days, any hosp (added)
1	A	AAA	AMI		1	--	1
2	A	BBB	AMI		0	12	0
3	B	AAA	AMI		1	--	1
4	B	AAA	Broken leg		0	28	0
5	C	BBB	AMI		1	--	1 0
6	C	BBB	AMI (subsequent)	CABG	0	18	0
7	D	AAA	AMI		1	--	0
8	E	BBB	AMI		0	--	0

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Questions/Comments?

Step 4: Calculate Weighted Statistics

1. Define index events
2. Determine the time between events
3. Identify readmissions
4. **Calculate nationally weighted statistics**
5. Report readmission rates

Calculate Weighted Statistics: Overview

- The NRD is a sample of discharges that needs to be weighted to calculate national estimates.

- The sample design must be factored into any estimate of variance.
    - The stratum are defined by the data element NRD_STRATUM
    - The discharges are clustered in hospitals indicated by the data element NRD_HOSP

- NRD_HOSP is an HCUP hospital identifier created specifically for the NRD. Its purpose is to identify records that are associated with the same hospital. NRD_HOSP does not link to other HCUP databases or to external databases.

Calculate Weighted Statistics: SAS Code

proc surveymeans data=NRDcore sum mean ;
   strata NRD_STRATUM;
   cluster HOSP_NRD;
	Proc Surveymeans used with a strata and cluster statement takes into account the complex sample design of the NRD when calculating standard errors and standard deviations.

weight DISCWT;	A weight statement is necessary to calculate national estimates.
domain IndexEvent ; var Readmit1 Readmit2 Readmit3;	Specify how results are to be stratified and which variables to use in the calculations.
ods output domain=OutputData ;	Output weighted results into the data set called OutputData.

Step 5: Report Readmission Rates

1. Define index events
2. Determine the time between events
3. Identify readmissions
4. Calculate nationally weighted statistics
5. **Report readmission rates**

Report Readmission Rates: Overview

- A readmission rate is often defined as the number of readmissions divided by number of index events.

- Readmission rate = # readmission / # index events

- If readmissions are identified by a 0/1 variable
  - The readmission rate is the weighted mean of the readmission variable (when the index event flag is equal to 1).
  - The number of readmissions is the weighted sum of the readmission variable (when the index event flag is equal to 1).

```
proc surveymeans data=NRDcore
sum mean ;
    strata NRD_STRATUM;
    cluster HOSP_NRD;
    weight DISCWT;
    domain IndexEvent  ;
var Readmit1 Readmit2 Readmit3;
ods output domain=OutputData ;
run;
```

The sum of the readmission variable(s) is the number of readmissions.

The mean of the readmission variable(s) is the readmission rate.

```
data readmitStats;
    set OutputData ;
    where IndexEvent=1;
run;
```

Use a data step to subset the information from the Proc Surveymeans output specific to records that had an index event.

Report Readmission Rates: Example

- Readmit #1: All-cause within 30 days to <u>any</u> hospital
    - Unweighted rate = 3 readmissions / 4 index events = 0.75
- Readmit #2: All-cause within 30 days to <u>same</u> hospital
    - Unweighted rate = 2 readmissions / 4 index events = 0.50
- Readmit #3: Unplanned readmission within 30 days to any hospital
    - Unweighted rate = 2 readmissions / 4 index events = 0.50

KEY_NRD	NRD_ VisitLink	HOSP_ NRD	Index Event (added)	Readmit1 (added)	Readmit2 (added)	Readmit3 (added)
1	A	AAA	1	1	0	1
2	A	BBB	0	0	0	0
3	B	AAA	1	1	1	1
4	B	AAA	0	0	0	0
5	C	BBB	1	1	1	0
6	C	BBB	0	0	0	0
7	D	AAA	1	0	0	0
8	E	BBB	0	0	0	0

Report Readmission Rates: Severity

- Severity or risk adjustment may be beneficial when comparing readmission rates across hospital types or different patient populations.

- The NRD includes the following data elements:
  - 3M All Patient Refined DRG (APR-DRG)
    - APR-DRG severity of illness subclass
    - APR-DRG risk of mortality score
  - Comorbidity flags
  - Number of chronic conditions
  - Medicare Severity DRG and MDC
  - Principal and secondary diagnoses and procedures
    - ICD-9-CM codes and Clinical Classifications Software

Report Readmission Rates: Hospital Characteristics

- Hospital characteristics on the NRD:
  - Control/ownership of hospital
    - Government, nonfederal; private, not-for-profit; private, investor-owned
  - Teaching status of hospital
    - Metropolitan non-teaching, metropolitan teaching, non-metropolitan
  - Urban-rural location
    - Large metropolitan areas with at least 1 million residents, small metropolitan areas with less than 1 million residents, micropolitan areas, not metropolitan or micropolitan
  - Size of hospital based on the number of beds
    - Small, medium, large defined within region of the U.S., urban-rural designation of the hospital, in addition to the teaching status

- The NRD cannot be linked to external databases such as the American Hospital Association (AHA) Annual Survey of Hospitals.

Report Readmission Rates: Patient Characteristics

- Patient characteristics on the NRD:
  - Age
  - Sex
  - Community income quartile
    - Quartiles are relative to national distribution of the population in the data year
    - Assigned to the discharges based on the median household income of the patient's ZIP Code (*patient ZIP Code is not on the NRD*)
  - Urban-rural location of the patient's residence
  - Flag indicating patient is a resident of the State in which he or she received hospital care
  - Expected primary payer
    - Medicare, Medicaid, private insurance, self-pay, no charge/charity, other

- The NRD cannot be linked to external databases such as the Area Health Resource File (AHRF).

Summary of the NRD

- The NRD was designed to be flexible to various types of analyses of readmissions in the United States.

- The criteria to determine the relationship between multiple hospital admissions for an individual patient in a calendar year was left to the analyst using the NRD.

- Outcomes of interest include national readmission rates, reasons for returning to the hospital for care, and the hospital charges/costs for discharges with and without readmissions.

- The NRD is designed for analyses at the *national* level. It is not designed to support regional, State-, or hospital-specific analyses.

Limitations of the NRD

Limitations on Studying Pediatric Readmissions:
The 2013 NRD includes patients who were younger than 1 year from only 9 of the 21 SID. The weights for pediatric discharges were often higher than adult discharges.

Limitations from Using One Year of Discharge Data:
The NRD are annual files based on discharge date. Therefore, 30- or 60-day readmissions for patients admitted in the latter part of the year may not be captured if the subsequent admission crossed into the next year.

Limitations from Using State-Specific Patient Identifiers:
Patients who were hospitalized in one State and readmitted or transferred to a hospital in another State cannot be tracked in the NRD, because each of the SID uses different coding for their patient linkage numbers. The NRD includes nonresident patients because we want to retain discharges at border hospitals that provided care for patients in their community, even though that community happened to cross State borders.

NRD Online Tutorial

- The NRD online tutorial is available on the HCUP User Support Web site at:
  http://www.hcup-us.ahrq.gov/tech_assist/nrd/index.html

- The tutorial has two parts:
  1) Overview of the NRD database design
  2) Example of using the NRD

- Tutorial includes step-by-step SAS example for calculating national estimates for 30-day all-cause readmissions for AMI.
  - Example includes calculation of the average total charge for the index event and readmissions
  - Example SAS program can be downloaded

HCUP User Support & HCUP-US Web Site

- Easy access to information on:
  - HCUP databases
  - Tools and software
  - HCUP-related reports and publications
  - News and upcoming events
  - Technical assistance

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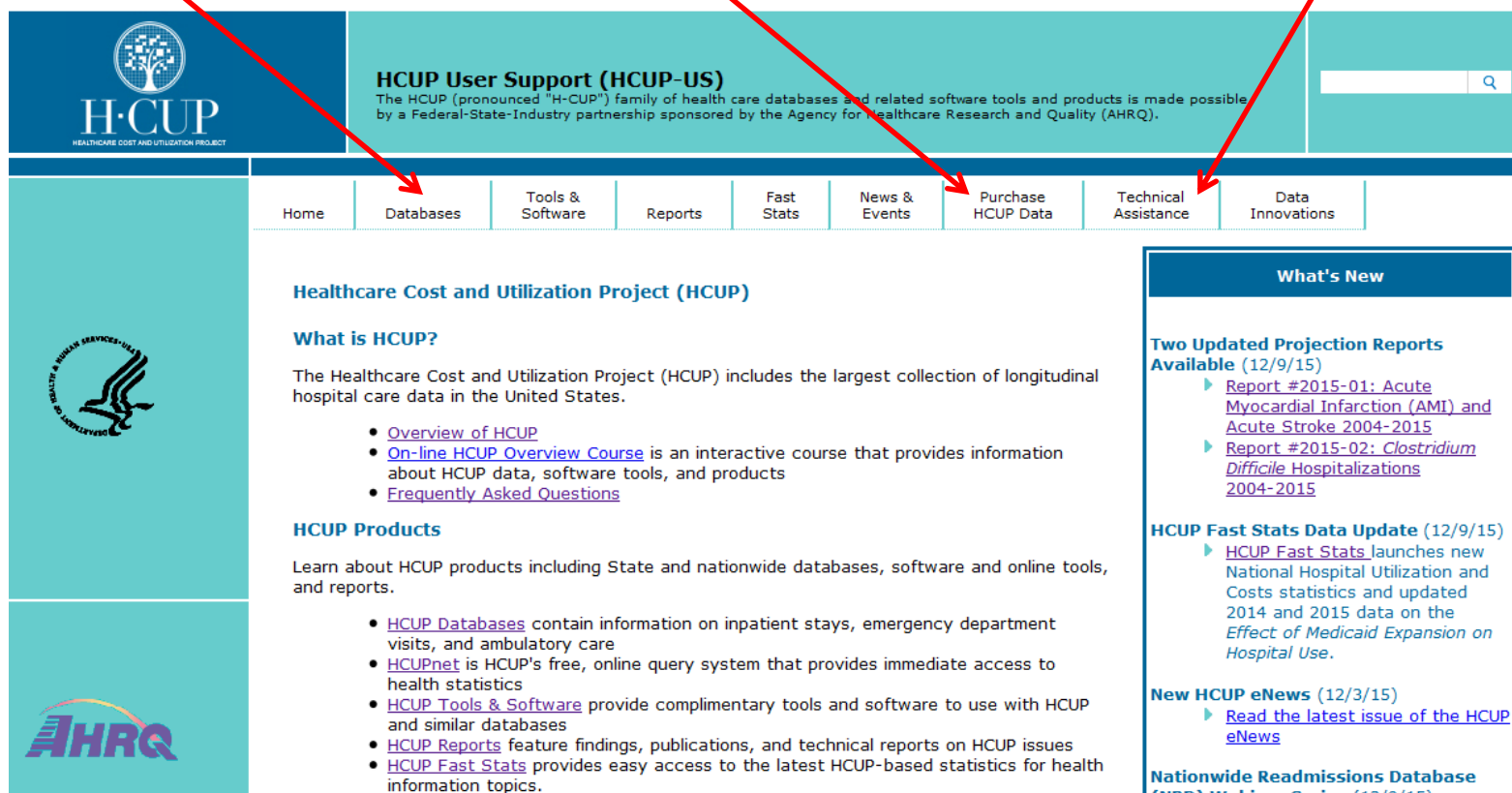
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NRD database documentation

Purchase the NRD

Technical assistance including online tutorials

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Healthcare Cost and Utilization Project (HCUP)

What is HCUP?

The Healthcare Cost and Utilization Project (HCUP) includes the largest collection of longitudinal hospital care data in the United States.

- Overview of HCUP
- On-line HCUP Overview Course is an interactive course that provides information about HCUP data, software tools, and products
- Frequently Asked Questions

HCUP Products

Learn about HCUP products including State and nationwide databases, software and online tools, and reports.

- HCUP Databases contain information on inpatient stays, emergency department visits, and ambulatory care
- HCUPnet is HCUP's free, online query system that provides immediate access to health statistics
- HCUP Tools & Software provide complimentary tools and software to use with HCUP and similar databases
- HCUP Reports feature findings, publications, and technical reports on HCUP issues
- HCUP Fast Stats provides easy access to the latest HCUP-based statistics for health information topics.

What's New

Two Updated Projection Reports Available (12/9/15)
- Report #2015-01: Acute Myocardial Infarction (AMI) and Acute Stroke 2004-2015
- Report #2015-02: *Clostridium Difficile* Hospitalizations 2004-2015

HCUP Fast Stats Data Update (12/9/15)
- HCUP Fast Stats launches new National Hospital Utilization and Costs statistics and updated 2014 and 2015 data on the *Effect of Medicaid Expansion on Hospital Use.*

New HCUP eNews (12/3/15)
- Read the latest issue of the HCUP eNews

Nationwide Readmissions Database (NRD) Webinar Series (12/9/15)

Webinar Resources on HCUP-US

- **Nationwide Readmissions Database (NRD) Online Tutorial**
  http://www.hcup-us.ahrq.gov/tech_assist/tutorials.jsp

- **Introduction to the NRD**
  http://www.hcup-us.ahrq.gov/db/nation/nrd/Introduction_NRD_2013.pdf

- **NRD database documentation**
  http://www.hcup-us.ahrq.gov/databases.jsp

- **Purchase the NRD**
  http://www.hcup-us.ahrq.gov/tech_assist/centdist.jsp

- **Methodological Issues when Studying Readmissions and Revisits Using Hospital Administrative Data**
  HCUP Methods Series Report # 2011-01 http://www.hcup-us.ahrq.gov/reports/methods/methods.jsp

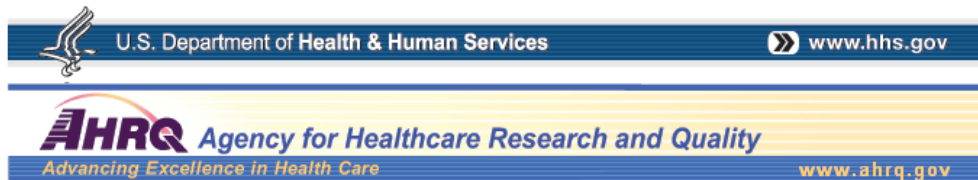# Using HCUP Technical Assistance

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